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Derrick J. Neufeld
University of Western Ontario, dneufeld@ivey.uwo.ca

Nicole Haggerty
University of Western Ontario, nhaggerty@ivey.uwo.ca

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Derrick J. Neufeld, Richard Ivey School of Business, The University of Western Ontario, dneufeld@ivey.uwo.ca
Nicole Haggerty, Richard Ivey School of Business, The University of Western Ontario, nhaggerty@ivey.uwo.ca

Abstract

Networks of teams rather than hierarchies of individuals are increasingly viewed as the appropriate organizational structure for coping with the turbulent environment facing most organizations today. Consequently, it is important that the educational system deliver individuals who are capable team players. This is doubly important in the field of information systems, where IT personnel are frequently cited as lacking in interpersonal and teams skills, and where IT work is increasingly structured around team based projects. In this exploratory study, a team learning pedagogy was utilized in the delivery of a database management systems course. This collaborative teaching methodology required students to bear sole responsibility for learning in teams, with the Professor acting as a "guide on the side" (Michaelsen, et al., 1993). Results indicate that this teaching methodology is effective in developing important team skills that students can transport to the work environment.

Keywords: learning models, IS teams, skill requirements, IS education, IS personnel

Introduction

Networks of teams rather than hierarchies of individuals are increasingly viewed as the most appropriate organizational structure for coping with the turbulent environment facing organizations today (D'Andrea-O'Brien and Buono, 1996). However, not all groups of people working together constitute a team (Katzenbach and Smith, 1993). Typical non team-based work groups are characterized by individual leadership, individual accountability, and individual work products (which taken together compose the "group output"). In contrast, integrated teams are characterized by shared leadership, individual as well as mutual accountabilities, and unified, collective work products. Consequently, in order for teamwork to be successful, team members require a high level of individual maturity, commitment, and the interpersonal and collaborative skills (Senge, 1990).

Given the proliferation of teams as a significant work structure, we believe that it is imperative that the educational system prepare individuals who are capable of performing effectively in teams. Interestingly, in the information systems field, practitioners have frequently complained that the educational system has failed to deliver graduates with the necessary components of team skills, specifically, business and interpersonal skills (Lee, et al., 1995). How are these skills to be developed? We propose here that a collaborative, team learning pedagogy can be employed to concomitantly develop both technical knowledge and skills, and team knowledge and skills. Thus, we examine the question, *"Is team learning effective in increasing students' technical knowledge and team skills?"*

Conceptual Development

Learning theory, combined with instructional design theory, explains how individuals learn, and offers direction as to how instruction should be conducted to maximize individual acquisition of knowledge. Generally, learning theories can be classified as objectivist or constructivist (Jonassen, et al., 1995; Leidner and Jarvenpaa, 1995).

Objectivist learning theory espouses the notion that knowledge exists as an objective reality, independent from the observer. Abstract or generalized models that can be transferred to the learner are representative objective knowledge (Jonassen, et al., 1995; Leidner and Jarvenpaa, 1995). The goal of instructional design under objectivist learning theory is to create a learning environment and learning situations in which the instructor is able to transmit, efficiently and effectively, this objective knowledge to the learner. If the learner fails to understand the knowledge transferred to them, then this represents an incomplete transfer of knowledge. In practice, objectivist learning theory is the main pedagogical assumption underlying the lecture method of instruction. In this method, the "sage on the stage" imparts knowledge to students in the class (Michaelsen, et al., 1993). Interaction, if it occurs, is generally between the student and the instructor, and serves the purpose of clarifying information being provided by the instructor so that correct knowledge transfer can be accomplished.

In contrast, constructivist learning theory states that knowledge does not exist as an objective reality, but is constructed by each learner. The mind of each learner produces its own interpretation of reality and consequently each learner develops a slightly different

model of reality. The goal of instructional design under constructivist learning theory is to create a learner-centered environment that enables learners to discover knowledge for themselves through interactions with their environment (Jonassen, et al., 1995; Leidner and Jarvenpaa, 1995).

A number of variations of constructivist learning theory have emerged, including collaborative learning that focuses on group interactions, cognitive information processing that focuses on learning styles and individual differences, and sociocultural learning that focuses on individual cultural contexts (Leidner and Jarvenpaa, 1995). For the purposes of the present study, attention was focused upon collaborative learning theory, and the team learning instructional approach, as the bases for model development.

Whereas a pure constructivist views knowledge generation as occurring between the individual and his or her environment, in collaborativism, individual knowledge is created as part of a larger social process. Specifically, individuals learn through interaction and dialogue with other learners. In instructional design terms, the goal of collaborativism is to create a learning environment that promotes group interaction among the students, between the students and the instructor, and between the students and the content. In practice, this type of instruction is characterized by methods such as case studies, group projects, debates, simulations, group problem solving activities, and team-based learning activities (Alavi, 1994; Hiltz and Benbunan-Fich, 1997; Jonassen, et al., 1995).

Researchers have noted that simply placing individual students in small groups for learning tasks is not sufficient to create a collaborative learning environment (Michaelsen, 1992). Careful preparation is required to ensure that student interactions are deep and meaningful (Hooper, 1995). Collaborationist education depends on active learning. The active learner's role is not to listen-memorize-repeat, but to enthusiastically engage and be engaged by the learning environment, while constructing his or her individual view of reality. To a collaborationist, the goal of the learning process is meaning-making, and this is best embedded in the processes of articulation and reflection that emerge from the learner's interaction with the material, their peers, and the instructor. An important component is that learning best occurs in 'naturalistic' settings, so that the learner is able to transition effectively to solving real world problems.

Burge (1994) found that colleagues play an important role in an individual learner's performance. Intensive peer interactions provide the individual with opportunities to gain feedback and integrate new knowledge with old knowledge. Further, peer interactions such as debate, discussion, and experience sharing enable the learner to elaborate on the meaning of an application or concept, and thus enhance cognitive development. Effective collaborativist learning theory is manifested in the learner's recognition of the importance of working actively with his or her peers, and the way in which the learner thinks, acts, and feels about the learning process. Thus, not all group work in education constitutes collaborativism. (Indeed, we strongly suspect that group project assignments in most lecture-based courses are frustrating to students, do not develop higher level team skills, and that group members meet merely to divide up the workload – a phenomenon that has been called "integration by stapler.") These arguments buttress the notion that organizational work groups are not necessarily teams (Katzenbach and Smith, 1993).

One instructional design methodology emerges as a strong combination of education in naturalistic settings and collaboration between learners – team learning. A team learning environment is characterized by the use of almost all available class time for group work, a heavy reliance on peer teaching, shared leadership roles within the assigned teams, both individual and mutual learning accountability, collective work products, and doing things together (Herreid, 1998; Michaelsen, 1992). The instructor's role is to plan and motivate learning in the session through the group work assigned, to circulate among teams and provide coaching advice, and to provide frequent performance feedback to individuals and teams. Learning occurs through the students' discovery, probing, practice, contrast, and comparison of their current level of understanding and their interactions with the instructor, their peers, and the material itself.

Team learning is an exceptional example of collaborative learning since it almost completely relies on peer to peer interaction, with very little intervention on the part of the instructor. Alavi et al., (1995, pg. 295-296) note more specifically how learners learn in such environments:

> "In collaborative learning situations, through conversations, discussion, and debate, participants offer explanations, interpretations, and resolutions to problems. This leads to active and social construction of knowledge and development and internalization of meaning and understanding. Furthermore, group discussions reveal different views and enable a more comprehensive conception and understanding to emerge."

Collaborative team learning closely mimics teamwork in organizational life. Yet very few empirical studies exist that specifically measure the ability of this pedagogical approach to develop team skills. Generally speaking, empirical research on interaction in the classroom coincides with results suggested by learning theory—that individuals learn best in collaborative environments with high levels of interactivity (Alavi,

1994; Hiltz and Benbunan-Fich, 1997; Johnson and Johnson, 1989). However, empirical examination of collaborative learning has generally focused on factors about the environment important to learning, or on learning outcomes such as content mastery or satisfaction. Very little empirical research has specifically investigated content mastery and the nature of the development of specific team based skills over a period of time within the context of team learning instructional design. Consequently, our research propositions are as follows:

P1: The team learning pedagogy enables increasing content mastery over time.

P2: The team learning pedagogy encourages development of individuals' team task and team maintenance behaviors, and inhibits development of anti-team behaviors.

Research Setting

A database management course offered at a large Canadian university provided the research setting. The sample consisted of 14 teams containing a total of 65 MIS majors who were enrolled in the course as part of a four-year undergraduate business degree program. Course objectives were threefold: to develop data modeling and database implementation skills; to develop SQL querying skills; and to improve students' understanding of data management concepts and challenges.

The course was carefully constructed using team learning instructional design recommendations (Michaelsen, et al., 1999; Michaelsen, et al., 1993; Michaelsen, 1992). For example, because heterogeneous teams usually outperform teams composed of individuals with similar characteristics and backgrounds, the professor constructed the fourteen teams in such a way as to maximize team heterogeneity with respect to previously completed coursework, University starting year (as a proxy for age/experience), and gender.

The class met 26 times, for 80 minutes per meeting. Class meetings took several forms, including eight minitest classes, eight exercise classes, and ten other classes (e.g., guest speakers, laboratories, team project preparation, etc.).

Definitions and Measures

Pedagogy is defined as "the art or technique of teaching" (Wordsmyth, 1999). In this study, team learning pedagogy refers specifically to the team-oriented classroom practices outlined in Michaelson, et al. (1999, 1993, 1992), such as discussions, exercises, minitests, labs, and project work, all conducted in the context of a learning team.

Content mastery refers to a student's attainment of target skills and knowledge. Content mastery was measured in this study using eight minitests administered at regular intervals throughout the course, focused on database design and development skills, database querying skills, and conceptual data management knowledge. Each minitest consisted of an individual phase, a team phase, and an appeal phase. During the individual phase each student completed a closed-book test made up of 15-20 multiple choice or true/false questions developed from the assigned readings. Minitest questions were carefully crafted by the instructor to assess content mastery, and ranged in difficulty and variety. During the team phase students met in their learning teams and completed the same closed-book minitest, but this time freely shared their skills and knowledge with their team mates, frequently questioning and challenging one another's statements. During the appeal phase, individual and team tests were scored and returned to students (with the help of a portable Scantron machine in the classroom). Teams were then encouraged to develop written appeals to support any "incorrect" answers that the team believed were justifiable.

Team behavior definitions were drawn from a team learning seminar offered by Larry Michaelsen from the University of Oklahoma. Team task behavior is defined as "behavior that contributes to task accomplishment and helps to cultivate a work climate" (these behaviors are manifested by such activities as initiating work, seeking information, giving information or opinion, elaborating, and summarizing). Team maintenance behavior is defined as "group member behavior required for maintaining the group as a working unit" (such behaviors are evidenced by such activities as encouraging, expressing group feelings, harmonizing, gatekeeping, and setting standards). Finally, anti-team behaviors are defined as "attempts by members of a group to satisfy individual needs which are irrelevant to the group task and which are not oriented to team building and maintenance" (anti-team behaviors include blocking, recognition-seeking, domination, and avoidance).

From these definitions, fourteen items were developed for this study to capture the three dimensions of team behavior. A confidential, peer-rated survey was constructed in which each student was asked to evaluate how frequently each of his or her team members had engaged in each behavior, using a four-point scale from zero (Never) to three (Frequently). Team task, team maintenance, and anti-team behavior scores were calculated for each student using the average of the scores attributed by the student's teammates. The team behavior survey was conducted midway through the course, and again at the end of the course. Assessing behaviors using peer responses ensured that an individual's team behaviors were measured according to how others on the team felt that the individual had behaved, providing an objective rating. Secondly, gathering this information

midway and at the end of the term enabled us to examine the development of individual team skills over time.

Results

In order to test the first proposition, that the team learning pedagogy increases content mastery over time, we examined differences in individual and team results (pre-appeal) for each of the eight minitests using paired t-tests. As shown in Table 1, for all eight minitests, the average team scores were significantly higher than the average individual scores. Drilling further into the data, we discovered that the team score exceeded the team's best individual score in 95.0% of the cases.

Table 1. Individual vs. Team Content Mastery Over Time

Minitest	Individ. Avg.	Team Avg.	Absolute Diff.	*t*
1	71.2%	86.1%	+14.9%	11.9***
2	64.2%	84.1%	+19.8%	11.9***
3	66.1%	79.7%	+13.6%	10.2***
4	70.8%	89.3%	+18.5%	11.2***
5	68.4%	89.6%	+21.2%	13.4***
6	66.4%	86.0%	+19.6%	10.6***
7	77.7%	92.4%	+14.7%	11.1***
8	71.8%	88.5%	+16.7%	10.8***

*** $p < .001$

Before testing proposition two, to determine whether team learning enhanced team behaviors over time, we examined the structure and properties of the items. Content validity was established by deriving the team task, team maintenance, and anti-team items according to previous research and conceptual work on team learning. A principal components factor analysis was performed to examine the construct validity of the 14 items. Results indicated a two-factor solution with 75% of the variance extracted. The five team task and five team maintenance items loaded onto a single factor (item loadings ranged from .81 to .91). Three of the four anti-team behaviors loaded onto a second factor (item loadings ranged from .89 to.94). The fourth anti-team behavior item did not load well onto either factor, and was discarded.

Given the two-factor solution, we derived individual scores for each of the two team behaviors for the midway score and final score and compared them for each student using paired t-tests (see Table 2). The results show a significant difference between the midway and final scores for team task and maintenance behavior, but not for anti-team behavior. Examining the mean scores, it is evident that on average, individuals were rated as increasingly exhibiting team oriented behaviors.

Table 2. Team Behaviors Over Time

	Task & Maint. Behaviors	Anti-team Behaviors
Midway – Avg.	2.12	.22
Final – Avg.	2.34	.27
Δ	.22	.05
t	6.11***	-1.63 n.s.

*** $p < .001$

Differences in the ten individual items for team task and team maintenance behaviors were examined using a repeated measures ANOVA, to determine which skills in particular that individuals developed over time. Eight of the ten behaviors improved significantly between the midway and final time periods in the course. Specifically, students improved four task-oriented team skills: (1) initiating work and ideas ($F=6.93$, $p<.01$); (2) providing information to the team ($F=8.16$, $p<.01$); (3) elaborating and summarizing group ideas ($F=15.52$, $p<.001$); (4) testing workability of group ideas ($F=19.16$, $p<.001$). Students also improved four maintenance-oriented team skills: (5) expressing group feelings ($F=31.03$, $p<.001$); (6) harmonizing and reconciling ($F=5.66$, $p<.05$); (7) gate-keeping and facilitating others' participation ($F=48.37$, $p<.001$); and (8) setting standards for the group to achieve ($F=47.86$, $p<.001$).

Discussion

This paper examined the effectiveness of team learning in a management information systems classroom setting, based on the theoretical underpinnings of collaborative learning theory. Teams consistently outperformed the best individuals, suggesting that team learning effectively enables content mastery. Task-oriented and maintenance-oriented team behaviors, as assessed by peers, improved over time, suggesting that team learning effectively enables development of team skills.

Beyond the obvious need for content mastery, development of team skills is critically important to IT personnel, since they will increasingly find themselves working in organizational teams. Practitioners have frequently complained that recent IT graduates, while they possess relevant technical skills, do not possess the necessary business and interpersonal skills to perform well when they enter an organization. This study demonstrates that team-based instructional design can improve the business and interpersonal skills of IT students, and we believe these classroom-developed skills will be highly transportable to team-based work environments.

While the current study provides initial support for the efficacy of the team learning instructional approach in IT courses, several limitations should be noted. First, the study was conducted in a single course – database

management. While there is no reason to believe it could not be equally successful with other types of IT course content (such as Telecommunications or Systems Development), future research should investigate its applicability to other course settings. Additionally, the data were collected over a single course term on a single group of students. Duplication of results in multiple terms and with multiple groups of students would enhance generalizability.

This study contributes to our understanding of the efficacy and benefits of team learning in MIS education. The method can deliver students with a well-rounded skill set including technical, business and interpersonal, benefiting both the student and practitioners. What remains is a call to MIS educators to burn their lecture notes, and experiment with this novel, challenging and rewarding approach to teaching management information systems courses.

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